

WHAT IS CLAIMED IS:

1. A Raman amplifier, comprising:

an optical fiber that propagates and amplifies a second signal light that is a wavelength-multiplexed signal of a first signal light and a
5 reference light, wherein the first signal light includes a plurality of wavelengths and the reference light is out of a wavelength range of amplification;

an excitation light source that outputs an excitation light for amplifying the second signal light;

10 a beam splitter that splits a portion of the second signal light into the first signal light and the reference light;

a signal light level detecting unit that detects a level of the first signal light;

a reference light level detecting unit that detects a level of the
15 reference light; and

a signal level setting unit that, based on the level of the reference light, calculates a target value to control signal light level for constantly maintaining a Raman gain, and controls the output level of the excitation light in such a way that the first signal level matches with
20 the target value.

2. The Raman amplifier according to claim 1, wherein the signal level setting unit controls the output level of the excitation light in such a way that the target value P_{s_on} is calculated as:

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$$P_{s_on} = P_{s_off} \times G \times (P_{ref} / P_{ref_init})$$

where, P_{s_off} is the level of the first signal light before being amplified, P_{ref_init} is the initial level of the reference light, P_{ref} is the level of the reference light after the second signal light is amplified, and G is the Raman gain.

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3. The Raman amplifier according to claim 1, wherein the reference light is a monitoring control light that is employed in an optical transmission system.

10 4. The Raman amplifier according to claim 1, further comprising:
a gain equalizer that corrects a wavelength-dependent gain profile of the amplified second signal light.

15 5. The Raman amplifier according to claim 1, further comprising:
a rare-earth-doped optical fiber amplifier that amplifies the Raman-amplified signal lights, by a specific gain; and
a variable attenuator that attenuates a level of the signal light amplified by the rare-earth doped optical fiber amplifier to a desired value.

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6. The Raman amplifier according to claim 1, further comprising:
a reception light level sensing unit that, when the reference light level falls below a specific value, forcibly lowers the output of the excitation light below a specific value before the target signal level
25 setting unit controls the excitation light source.

7. An optical relay transmission system comprising:
- a signal light transmitting unit that outputs a signal light that has a plurality of wavelengths, wavelength-multiplexes and transmits the signal light;
 - 5 a reference light output unit that outputs a reference light of a wavelength that is out of a wavelength band of the signal light;
 - a Raman amplifier that amplifies, based on the reference beam, the wavelength-multiplexed signal light, wherein the Raman amplifier includes
 - 10 an optical fiber that propagates and amplifies a second signal light that is a wavelength-multiplexed signal of a first signal light and a reference light, wherein the first signal light includes a plurality of wavelengths and the reference light is out of a wavelength range of amplification;
 - 15 an excitation light source that outputs an excitation light for amplifying the second signal light;
 - a beam splitter that splits a portion of the second signal light into the first signal light and the reference light;
 - a signal light level detecting unit that detects a level of
 - 20 the first signal light;
 - a reference light level detecting unit that detects a level of the reference light; and
 - a signal level setting unit that, based on the level of the reference light, calculates a target value to control signal light level for
 - 25 constantly maintaining a Raman gain, and controls the output level of

the excitation light in such a way that the first signal level matches with the target value; and

a signal receiving unit that receives the signal light amplified by the Raman amplifier.

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8. The optical relay transmission system according to claim 7, wherein a plurality of Raman amplifiers, including a first Raman amplifier and a last Raman amplifier, are cascaded in such a manner that the first Raman amplifier receives the wavelength-multiplexed
10 signal light and the signal receiving unit receives the signal light amplified by the last Raman amplifier.